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# SETUP TIME REDUCTION OF MACHINES IN VARIOUS MANUFACTURING INDUSTRIES USING SMED TECHNIQUES – CASE STUDIES

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***ABSTRACT***

***In this aeon of globalization, manufacturing industries need to be more flexible in production by reducing the batch size. So that any kind of customer demands can be met by the industry. Now most of the industries are not able to attain this flexibility due to the large setup time involved in the process. To overcome this intricacy the lean manufacturing tool Single minute exchange of die (SMED) is applied to the significant machine. So this paper deals with the application of SMED in various manufacturing industries to reduce the setup time. As an upshot the setup time is reduced gradually to a limit.***

***KEYWORDS: External Activity, Extruding Machine, Internal Activity, Single Minute Exchange If Die & Turret Machine***

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Original Article

## INTRODUCTION

Manufacturing industries are in a scurry to attain the flexibility in production. Because of the globalization; the competition in each kind of industry is very high. Whichever industry is able to meet the customer demands with quality within the limited time period they will be at the top position. So in order to be in the top position the industry need to purge all kinds of wastages. For that purpose the lean manufacturing techniques are playing a vital role. Lean manufacturing can be considered as a way living in a qualitative manner within the industry. It brings changes in working manner, workers' attitude and standard format for every process. Single minute exchange of die (SMED) is a lean manufacturing tool, which is used to reduce the setup time of machines and allow reducing of lot size. The flexibility to alter the production of different products or operations is incurred by this SMED technique. SMED reduce the non-productive time by streamlining and standardizing the operations for exchange tool, using simple techniques and easy application (1). It provides a rapid and efficient way of converting a manufacturing process from running the current product to running the next product (2). SMED is a process and not merely a program because a program has a beginning and an end. Therefore, constant sustaining and improvements through SMED must be continuously implemented (3). SMED methodology was applied to prepare an optimal standard procedure for changeover operations on defined machine. Ergonomics and safety issues were also taken into consideration during setups. Since an ergonomic workplace makes operations easier for the operators, simple, however crucial changes are suggested (4). Primarily two types of activities are there internal activity and external activity. Internal activities are the activity which performs only after turning off the machine. Where, external activities are the activity which performs even as the machine executes the work.

## METHODOLOGY

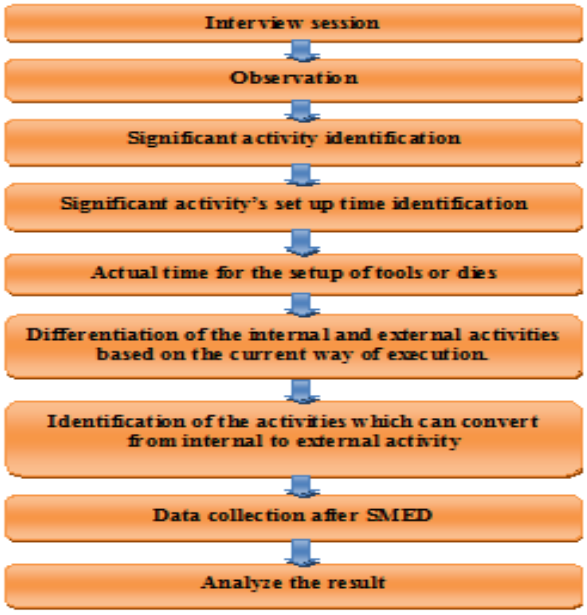


**Figure 1: Methodology**

## CASE STUDY

### CASE STUDY – I: HYDENSO ENGINEERING PRIVATE LIMITED, PALAKKAD

- **SMED – CNC TURRET PUNCHING MACHINE**

A CNC Turret punching machine is used for the metal forming through punching as per the design applied (5). It is mostly used to punch on the sheet metal of various gauges. It has a wide variety of punching tools: holes of varying sizes, notches and straight edges (5). From the interview session conducted among the supervisors and workers it is clearly understood that, the turret machine is the key machine which initiates the production with high setup time, also it needs the most tools changing for a variety of products. So As per the initial study it knows that SMED technique can be done in the turret machine to reduce the total setup time. So as the first step of SMED the activity breakdowns are done with the help of video study and physical observation. The activities are differentiated based on the current way of execution.

**Table 1: Set up Activity Breakdown of Turret Punching Machine**

| SL. NO | ACTIVITY | DURATION | INTERNAL (sec) | EXTERNAL (sec) | OBSERVATION |
|---|---|---|---|---|---|
| 1 | Searching next drawing in computer | 5min | ------ | 300 | waiting for the senior |
| 2 | Modification in CNC program | 6min | ------ | 360 | In-charge is correcting the program |
| 3 | Searching for tool(punch) removing tools | 1min50sec | 110 | ------ | Punches are kept without identification |
| 4 | Removal of old tool assembly | 2min01sec | 121 | ------ | |
| 5 | Searching for new tool | 2min11sec | 131 | ------ | Lack of tools |
| 6 | Walk to senior for confirming tool | 1min6sec | 66 | ------ | |

| Table 1: Contd., | | | | | |
|---|---|---|---|---|---|
| 7 | Walk to bench vice | 30sec | ------ | 30 | |
| 8 | Dismantling old tool assembly | 2min35sec | 155 | ------ | |
| 9 | Assembling new tool | 5min30sec | 330 | ------ | |
| 10 | Walk back to turret | 20sec | ------ | 20 | |
| 11 | Finding turret assembling tools | 1min15sec | 75 | ------ | Kept in different places |
| 12 | Removal of base plate | 3min18sec | 198 | ------ | |
| 13 | Walk for tool | 20sec | ------ | 20 | |
| 14 | Removal of punch | 1min | 60 | ------ | |
| 15 | Cleaning and oiling of punch & base plate | 2min | 120 | ------ | |
| 16 | New assembling tool fixing to turret | 8min | 480 | ------ | |
| 17 | Walk and collecting 20 new sheets | 3min | 180 | ------ | After completing the tool assembly new sheets are taken |
| 18 | Modification in CNC program | 5min | ------ | 300 | |
| | **Total** | **50min56sec** | **2026** | **1030** | |
| | | | **33.76 min** | **17.16 min** | |

Based on the activity breakdown and timings for the activity, the activities are converted from internal execution to external execution. So that the total setup time can reduce.

**Table 1: Conversion of Internal Activity to External Activity**

| SL. NO | ACTIVITY | DURATION | INTERNAL (sec) | EXTERNAL (sec) | TECHNIQUES USED |
|---|---|---|---|---|---|
| 1 | Searching next drawing in computer | 1min30sec | ------ | 90 | All the data sorted out in different folders |
| 2 | Modification in CNC program | 6min | ------ | 360 | |
| 3 | Searching for tool removing tools | 50sec | ------ | 50 | New tool board is placed near the machine |
| 4 | Removal of old tool assembly | 2min01sec | 121 | ------ | |
| 5 | Searching for new tool | 40sec | ------ | 40 | Tools are arranged properly with identification |
| 6 | Walk to senior for confirming tool | Nil | ------ | 0 | Number Format created for the tool holder, And the same no. Given to the tool also |
| 7 | Walk to bench vice | 30sec | ------ | 30 | |
| 8 | Dismantling old tool assembly | 2min35sec | 155 | ------ | |
| 9 | Assembling new tool | 5min30sec | 330 | ------ | |
| 10 | Walk back to turret | 20sec | ------ | 20 | |
| 11 | Finding turret assembling tools | 30sec | ------ | 30 | New tool board is placed near machine |
| 12 | Removal of base plate | 3min18sec | 198 | ------ | |
| 13 | Walk for tool (punch) | 20sec | ------ | 20 | |
| 14 | Removal of punch | 1min | 60 | ------ | |
| 15 | Cleaning and oiling of punch & base plate | 2min | 120 | ------ | |

| Table 2: Contd., | | | | | |
|---|---|---|---|---|---|
| 16 | New assembling tool fixing to turret | 8min | 480 | ------ | |
| 17 | Walk and collecting 20 new sheets | 3min | ------ | 180 | New sheets will collect at the time of last run of machine |
| 18 | Modification in CNC program | 5min | 0 | 300 | |
| | Total | 43min04sec | 1464 | 1120 | |
| | | | 24.4 min | 18.66 min | |

Along with that certain kaizen are also added to ease the work. With the help of these kaizen the time reduced in the external activities. Even though it does not reduce the total setup time, they play a remarkable role.

| Turret Punching Machine | SMED Checklist are Placed on the Machine |
|---|---|
|  |  |

**Figure 2: Turret Punching Machine**

## RESULTS

**Table 2: Time Savings Due to SMED on Turret Machine**

| Activity | Time Before | Time After | Time Difference |
|---|---|---|---|
| Total time Due to the conversion of internal activity to external activity. | 33.76min | 24.40min | 9.36min |
| Time saved by other activity within external activities. | 12.8min | 6min | 6.8min |

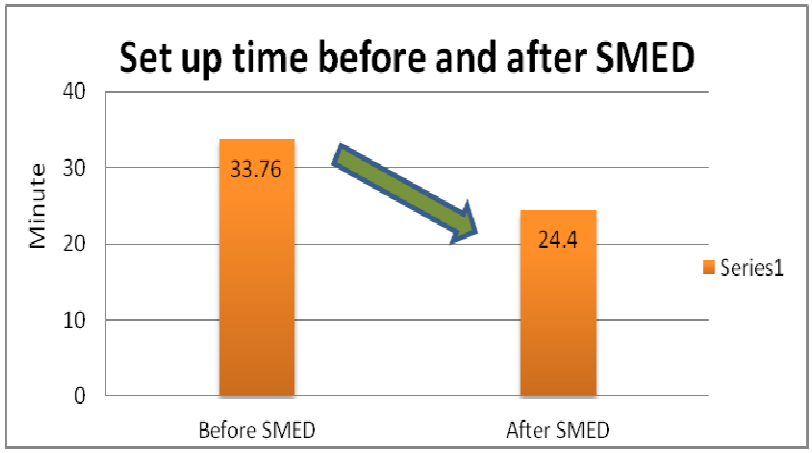


**Figure 3: Comparison of Time before and after SMED Implementation**

In the setup time calculation the internal activities are measuring the time needed for the entire setup of a machine. By analyzing the data collected before SMED and after SMED, it is understood that the total setup time is reduced from 33.76 minutes to 24.4 minutes. With the help of Kaizen involved in the process, the time of external activities is reduced from 12.8 minutes to 6.0 minutes.

## CASE STUDY – II: SARK CABLES PRIVATE LIMITED

### SMED – EXTRUDER 55

Plastics extrusion is a manufacturing process in which raw plastic is melted and shaped into a continuous profile. Extrusion generates items such as pipe, tube, thermoplastic coatings, and wire insulation (6). Extruder 55 is used to extrude the PVC coating on the copper or aluminium wire for the purpose of insulating them. As we seen the coating on the electric wires are moving through this process. Different sized wires are there, for each type need different kind of dies to produce the appropriate coating. Extruder 55 is one of such extruding machine.

As per the study and observation, it is analyzed that the setup time is very high in extruding machine.

**Table 3: Activity Breakdown of Extruder – 55**

| SL.NO | ACTIVITY | DURATION | INTERNAL (sec) | EXTERNAL(sec) | OBSERVATION |
|---|---|---|---|---|---|
| 1 | Searching for wire cutting tools | 1min50sec | 110 | ------- | Tools are not arranged |
| 2 | Inlet side old wire cutting | 10sec | 10 | ------- | |
| 3 | Idle time | 8min0sec | 480 | ------- | It's at hot condition |
| 4 | Searching for die removing tools | 2min15 sec | 135 | ------- | Lack of tools in numbers |
| 5 | Removal of outer case of die | 1min10sec | 70 | ------- | |
| 6 | Removal of die and waste PVC | 3min24sec | 204 | ------- | |
| 7 | Selection of new die | 10min57sec | 657 | ------- | Die is not kept properly, kept in more than one location |
| 8 | Setting of new die | 6min0sec | 360 | ------- | |
| 9 | Removing loaded bobbin | 1min0sec | 60 | ------- | Kept in too many place |
| 10 | Loading new bobbin and its dummy wire | 6min0sec | 360 | ------- | |
| 11 | Trail run for PVC only | 3min | 180 | ------- | |
| 12 | Trial run | 3min | 180 | ------- | Defect identification zone |
| 13 | Inlet side old wire cutting | 20sec | 20 | ------- | |
| 14 | Re-arranging die set | 4min | 240 | ------- | |
| | | | 2931 | | |
| | **Total** | **48min 51sec** | **48.85min** | | |

The critical activities are identified from the breakdown procedure. Time taken for each activity is recognized. And the total time required for each activity was calculated as 48 minutes 51 seconds. At the present way of execution has done only by internal activities. There is no external activity took place. And based on this the required Kaizen or improvements are provided. The critical activity of this machine setup includes the selection of dies and searching of die dismantling and assembling tools. In order to overcome this exertion new tool board and tools provided near machine. Dies are kept in one place with size mentioning.

**Table 4: Conversion of Internal Activity to External Activity**

| SL. NO | ACTIVITY | DURATION | INTERNAL (sec) | EXTERNAL (sec) | TECHNIQUES USED |
|---|---|---|---|---|---|
| 1 | Searching for wire cutting tools | 40sec | ------ | 40 | New tools and tool board placed near the machine. |
| 2 | Inlet side old wire cutting | 10sec | 10 | ------ | |
| 3 | Idle time | 8min0sec | 480 | ------ | It's at hot condition |
| 4 | Searching for die removing tools | 40sec | ------ | 40 | New tools and tool board placed near the machine. |
| 5 | Removal of outer case of die | 1min10sec | 70 | ------ | |
| 6 | Removal of die and waste PVC | 3min24sec | 204 | ------ | |
| 7 | Selection of new die | 1 min | ------ | 60 | All the dies are kept near the machine as per the size order. |
| 8 | Setting of new die | 6min0sec | 360 | ------ | |
| 9 | Removing loaded bobbin | 1min0sec | ------ | 60 | Used bobbins are removed during the curing time |
| 10 | Loading new bobbin and its dummy wire | 6min0sec | ------ | 360 | New bobbins are loaded to the take up at the curing time |
| 11 | Trail run for PVC only | 3min | 180 | ------ | |
| 12 | Trial run | 3min | 180 | ------ | Defect identification zone |
| 13 | Inlet side old wire cutting | 20sec | 20 | ------ | |
| 14 | Re-arranging die set | 4min | 240 | ------ | |
| | | | 1744 | 520 | |
| | Total | 38min 24sec | 29.06min | 8.66 min | |

| Extruder Machine | Drawing Wire through Dies |
|---|---|
|  |  |

**Figure 4: Extruder Machine**

## RESULTS

**Table 5: Time Savings Due to SMED Application on Extruder Machine**

| Activity | Time Before | Time After | Time difference |
|---|---|---|---|
| Total time Due to the conversion of internal activity to external activity. | 48.85 min | 29.06 min | 19.79 min |

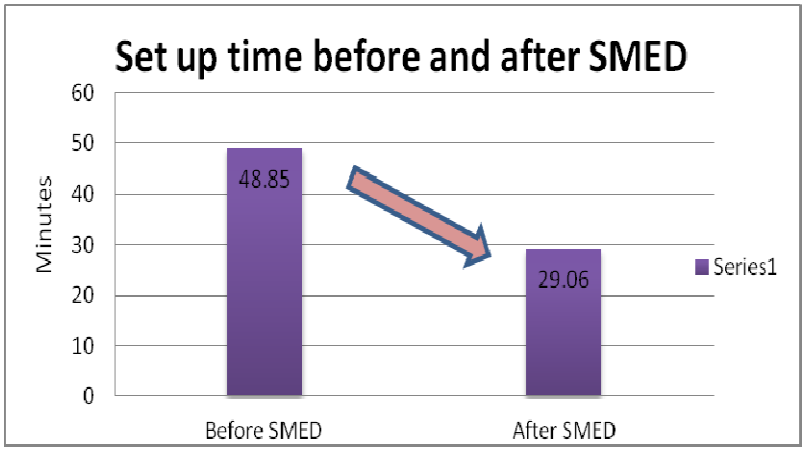


**Figure 5: Comparison of Time before and after SMED Implementation**

After the application of SMED technique certain activities are converted from internal execution to external execution. And as an improvement the total time for the activities are reduced from 48minute 51 seconds to 38 minutes 24 seconds. Before there were no external activities done, but now around 8.66 minutes internal activities are converted to external way of execution.

## CONCLUSIONS

Most of the industries are facing the issues of setup time during the product change or part variation. This study was related to reducing the setup time of various machines in different manufacturing industry. From the study it is understood that for various setups too much time is taken due to the wastages which was not taken care. By the application of single minute exchange of die on the turret punching machine and on the extruder 55; the total setup time is reduced by converting the simple internal activities to external activity. Also the time of certain internal and external activities are reduced by introducing certain Kaizen. The results proving that the lean manufacturing tool single minute exchange of die is an effective tool to reduce the set up time and wastages in the process.

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